UNIT-3

Physical layer
Transmission of digital information from one device to another is the basic function for the devices to be able to communicate.

1. Physical Interface
   The physical layers need to exchange protocol control information between known as physical interface.
   The physical layer uses the interconnecting medium for sending the protocol control signals.

   - Mechanical specifications of the connector
   - Type of connector (male or female) Function Specifications
   - Electrical characteristics of the signals
   - Procedure specifications

2. Physical layer standards
   Standards are essential in creating and maintaining an open and competitive market for equipment manufacturers and in guaranteeing national and international interoperability of data and telecommunications technology and protocols.

   Some of physical layer standards are EIA-232-D, EIA-449 etc.

3. EIA-232-D Digital Interface
   The EIA-232-D digital interface of Electronic Industries Association (EIA) is the most widely used physical medium interface. It is applicable to the following modes of transmission:

   - Serial transmission of data
   - Synchronous and asynchronous transmission
   - Point-to-Point and point-to-multipoint working
   - Half duplex and full duplex transmission.
Specifications

ETA-232-D defines all the formats of specifications for the physical layer interface between a DTE and a DCE. Mechanical specifications (ISO 2110 standard)

- Male connector for DTE port
- Female connector for DCE port

25-pin (DB-25) connector

Electrical specifications (V.28 standard)

- Line code used is NRZ-L
- Nominal voltage level +12 V for binary '0'
- Nominal voltage level -12 V for binary '1'
- +25-V limit is the open circuit or no load voltage
- -3V to +3V is the transition region and is not assigned any state

Upper limit

<table>
<thead>
<tr>
<th>State</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binary 0, On, Space</td>
<td>+12 V</td>
</tr>
<tr>
<td>Binary 1, Off, Mark</td>
<td>-12 V</td>
</tr>
</tbody>
</table>

Function specifications (V.28 standard)

25 functions of 25 pins

Procedure specifications (V.28 standard)

Sequence of events which comprise the complete procedure for data transmission can be divided into the following four phases:

- Equipment readiness phase
- Circuit assurance phase
- Data transfer phase
- Disconnect phase
Limitations of EIA-232-D:
- how data rate
- short distance data transmission application

These limitations are due to unbalanced transmission mode of its signals and shared common ground for all signals flowing in both directions.

1. **EIA-449 Interface**
   - EIA-449 interface overcomes the limitation of EIA-282-D.
   - Procedural specifications are same as EIA-282-D
   - Mechanical specification (ISO 4502 standard)
     - 87 pins connector
   - Electrical specification (Approx):
     - Jumper 0 : +5 V
     - Jumper 1 : -5 V
     - Jumper 2 : +12 V
     - Jumper 3 : -12 V

2. Function specifications:
   - 37 functions of 37 pins

5. **RJ45 (Registered Jack 45)** & **RJ11**
   - Most common UTP (unshielded twisted pair) connector
   - RJ45 is a keyed connector, meaning the connector can be inserted in only one way
   - Used in computer networking
   - RJ45 contains more wires than RJ11
   - RJ45 is physically larger than RJ11
   - RJ11 → Shielded twisted pair, and used in connecting telephone units
BNC Connector (Bayne-Neill-Connelman):
- Most common coaxial connector. Three types are:
  - BNC Connector: It is used to connect the end of the cable to a device such as a TV set.
  - BNC Terminator: It is used in Ethernet networks to branch out to a connection to a computer or other device.
  - BNC Terminator: It is used at the end of the cable to prevent the reflection of the signal.

MODEM (Modulation - Demodulation)

15 meters from the host

Broadly, a modem is composed of a transmitter, a receiver, and two interfaces:

- Digital Interface
- Transmission Medium
- Telephone Interface

Types of Modem:
1. Directional capability: half-duplex and full-duplex modem
2. Connection to the line: 2-wire modem and 4-wire modem
3. Transmission mode: asynchronous and synchronous modem
Features of modem:
1. High speed (bit per second) → 300, 600, 1200, 2400, etc.
2. Auto Dial/Redial a phone number
3. Auto Answer
4. Self-testing
5. Voice over data
6. Synchronous and asynchronous transmission
7. Echo cancellers
8. Secondary channel
9. Test loops → locating faults
10. Compromising and error control

Connecting devices:

<table>
<thead>
<tr>
<th>Application</th>
<th>Gateway</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Router or three-layer switch</td>
<td>Transport</td>
</tr>
<tr>
<td>Network</td>
<td>Bridge or two-layer switch</td>
<td>Network</td>
</tr>
<tr>
<td>Data link</td>
<td>Repeater or Hub (active)</td>
<td>Data link</td>
</tr>
<tr>
<td>Physical</td>
<td>Passive Hub</td>
<td>Physical</td>
</tr>
</tbody>
</table>

Passive Hub: It is just a connector.

Repeater: A repeater connects segments of a LAN. It forwards every frame. It has no filtering capability. A repeater is a regenerator, not an amplifier.

Active Hub: It actually a multipath repeater.

Bridge: As a physical layer device, it regenerates the signal it receives. As a data link layer device, the bridge can check the physical (MAC) address (source and destination) in the frame. A bridge has filtering capability.
Two-layer switch: It is a bridge with many ports and a design that allows better (faster) performance.

Router: It is a three-layer device that routes packets based on their logical addresses.

Three-layer switch: It is a router, but a faster and more sophisticated router that allows faster table lookup and forwarding.

Gateway: It is normally a computer that operates in all five layers of the Internet and uses layers of OSI model. Gateway can provide security.

2. Network topologies
   The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to one another.

   → Mesh = \( n(n-1)/2 \)
   → Star
   → Ring
   → Bus
   → Tree
   → Hybrid

Types of connection: Point-to-Point and multipoint (multidrop) connection.

3. Null Modem:
   It is a communication method to connect two DTE's directly using an EIA-232-D (RS-232) serial cable. With a null modem connection, the transmit and receive lines are cross-linked. Depending on the firmware, sometimes also one or more handshake lines are cross-linked. Several modem layouts are in use because the null modem connection is not covered by a standard.